The Effectiveness of Intravenous Magnesium Sulfate for Deliberate Hypotension in Rhinoplasty

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Background: Deliberate hypotension is a strategy that reduces intraoperative bleeding and increases the speed of surgery in otolaryngology procedures. Magnesium (Mg) sulfate is a vasodilator agent that reduces intraoperative hypnotic requirements and in combination with analgesic agents, it reduces intraoperative and postoperative pain. In this study we evaluated the use of intravenous Mg sulfate for inducing deliberate hypotension in rhinoplasty.

Methods: Sixty ASA I, II patients aged between 18 to 45, scheduled for rhinoplasty were recruited into a randomized clinical trial. Patients were randomly assigned into placebo (group P) and Mg sulfate (group M) groups. For patients in group M, 40m/kg Mg sulfate was administered before induction and continued with 15mg/kg/hr infusion during the operation. Patients of group P received normal saline as placebo. In each group mean arterial pressure (MAP), mean heart rate, amount of bleeding, anesthetic agents, opioid requirement and duration of surgery were recorded. The incidence of nausea, vomiting, shivering and the score of pain were recorded in post-operative period in both groups.

Results: Patients in group M had lower MAP (P= 0.0001), less intraoperative bleeding (P=0.0001), lower anesthetic agents (P=0.0001) and opioid consumption (P=0.001), and shorter duration of procedure (P=0.0001). Mean heart rate was lower in group P (P=0.001). Moreover, surgeon’s satisfaction was more in group P (P=0.001). They also had less incidence of post-operative nausea and vomiting (P=0.008), shivering (P=0.001) and lower pain scores postoperatively (P=0.0001).

Conclusion: Magnesium sulfate can be a useful drug to induce controlled hypotension in rhinoplasty surgery. By employing this agent patients have better anesthetic condition and recovery profile.

Keywords: magnesium sulfate; controlled hypotension; rhinoplasty

Hypotensive anesthesia is a strategy for reducing bleeding during surgical procedures and providing a perfect operative field in special conditions like head and neck surgeries [1-2]. By employing deliberate hypotension, the speed of surgery will improve because the surgeon has better view of operation field [3-5]. Nowadays there are many anesthetic techniques suggested to reduce mean arterial pressure (MAP) during operation by using various anesthetic agents or adjuvant drugs [3-6]. Magnesium (Mg) sulfate is a vasodilator agent which has a number of applications in anesthesia [7-14]. Mg sulfate reduces intraoperative hypnotic requirements and in combination with analgesic agents, it reduces intraoperative and postoperative pain [12-16], so in this study we aimed to evaluate the use of intravenous Mg sulfate for inducing controlled hypotension in rhinoplasty.

Methods

After obtaining institutional ethics committee and patients informed consent, sixty ASA I, II patients aged between 18 to 45, scheduled for rhinoplasty in our general hospital between March 2014 and March 2015, were recruited into a randomized triple blinded clinical trial. Patient with any history of underlying disease, obesity with body mass index greater than 30 and any history of drug abuse were excluded from the study. The study cases were randomly assigned into two groups by using computer random-generated code numbers which had been placed in opaque, sealed envelopes by a person not involved in the study. Patients were administered 40 mg/kg of solution of Mg sulfate 10% (group M, n=30) and normal saline as a placebo (group P, n=30), which were prepared in 500 ml normal saline bottles got ready by an expert anesthetic nurse and encoded by a secretary before induction of anesthesia. They also received 15mg/kg/hour infusion of the same prepared solution during the operation. The study was triple blinded because neither the patient, nor the surgeon and nor the anesthesiologist who anesthetized the patient were informed about the content of solutions to each patient were administered. After premedication with midazolam (0.02 µg/kg) and fentanyl...
(2µg/kg), induction of anesthesia was performed by propofol (2mg/kg), and atracurium (0.6 mg/kg) in all patients and then proper size ofuffed endotracheal tube applied for each patient in both groups. Infiltration of 2% lidocaine and 1:100,000 epinephrine was administered 10 min before surgery by the surgeon in all patients. The anesthesia was maintained by 50% N2O and 0.8–1.5% isoflurane, to achieve target mean arterial pressure (MAP). During the operation infusion of remifentanil (0.1-0.2µg/kg) was administered with either Mg sulfate 10% (15mg/kg/hour) or equal volume of normal saline as placebo in both groups. All patients were in 30 degree head up position during the procedure and monitored by electrocardiography, pulse oximetry, capnography and non invasive blood pressure measuring. The goal of intraoperative blood pressure was to maintain MAP between 55 to 75 mmHg, and if the patient developed with higher MAP, first the administered dose of isoflurane was increased to maximum 1.5% and then the infusion rate of remifentanil was increased up to maximum dose of 0.2µg/kg. Ephedrine was considered as vasopressor agent for MAP< 50 and atropine was considered as vagolytic agent for heart rate <60. Hemodynamic variables were recorded every 5 minute and total dose of remifentanil was record for each patient. All surgeries were performed by two surgeons. 

For estimation of the amount of bleeding in the surgical field, all the sterile gauze sponges in surgical set were weighed [2] by a KIA SCALE model BL 1000 with accuracy of 0.01 gr and after the operation, they were weighed once more and the difference in gram scale was calculated as 1.03 gr for each ml blood. The amount of blood in the suction was added to the result. 

The incidence of post-operative nausea and vomiting and shivering in the post anesthesia care unit (PACU) was recorded. We also recorded postoperative pain in PACU by employing PAULA the PAIN-METER [17].

At the end of each procedure, duration of surgery was recorded and the surgeon was asked about his satisfaction with the operative conditions. 

With the help of SPSS version 16 (SPSS Inc., Chicago, IL, USA), the data were analyzed by Mann-Whitney test, analysis of variance, and student t-test. P value ≤ 0.05 was considered significant.

Results

Two groups were similar with respect to demographic characteristics and showed no statistically significant difference. Also operative time and baseline vital signs did not differ among the groups (Table 1).

The average MAP was 57.50 ±1.7 in group M and 73.26 ±1.50 in group P, which was statistically significant different between two study groups (P=0.0001). Moreover, mean heart rate was 70. 56 ±1.81 in group M and 65.56±1.6 in group P, which showed statistically significant difference (P= 0.001). The amount of intraoperative bleeding was statistically less in group M compared with group P (228.66± 30.16 ml and 393.06±13.51ml respectively, P= 0.0001). Surgeons were satisfied with the surgical conditions in 28/30 cases (63.6%) in group M and 16/30 cases in group P (36.4%), which showed more satisfaction regarding surgical field in group M (P= 0.001). Meanwhile, operation time was statistically different in patient of group M compared to patients in group P (87.46±14.29 minutes versus 122.9± 19.30 minutes, P= 0.0001). Anesthesia team administered less anesthesia drugs in group M compared to group P (Table 1). Patients in group M had lower incidence of nausea and vomiting and shivering compared to patients in group P postoperatively (Table 1). Ephedrine was used for one patient (3.3%) in group M and 4 patients (13.3%) in group P (P=0.161). In addition atropine was used for 2 patients (6.7%) in group M and 4 patients (13.3%) in group P (P=0.389). Patients of group M had less pain compared to patients in group P which was statistically significant (P= 0.0001).

Discussion

Ear, nose and throat procedures, are prone to significant amount of bleeding due to hyper vascular areas of surgical field, so deliberate hypotension is necessary to improve the quality of surgical condition [2,18-19]. There are many anesthetic techniques which employ either anesthetic drugs with vasodilatory effects or some adjuvant antihypertensive agents to reduce MAP during operation [3-6]. Mg sulfate is a vasodilator agent which has a number of applications in anesthesia for many years [7-14].

In this study our aim was to evaluate the use of intravenous Mg sulfate for inducing deliberate hypotension in rhinoplasty. Deliberate hypotension is reduction of MAP to 50-65 mmHg or a 30% reduction of baseline MAP [1,3]. In this study the aim of MAP was between 55-75 mmHg which provided optimal surgical situation. In operations with deliberate hypotension, patients bleed less and they need fewer blood transfusions [20-21].

In this trial, we recorded lower average MAP in group M, and those patients who received Mg sulfate had lesser amount of intraoperative bleeding. The time of operation was less in this group, because the surgeon had better view of operation field and time consumption for suctioning blood and drying the surgical field was less [3-5]. Mechanism of vasodilation by Mg sulfate is first by inhibition release of calcium in smooth muscles and then by release of nitric oxide from endothelial cells, so it can directly reduce vascular tonic [7]. Calcium is a key ion component in release of catecholamines in response to sympathetic stimulation and magnesium inhibits calcium influx by blocking calcium ion channels [8-9]. This competition leads in blocking the release of catecholamines and adrenergic responses in sympathetic stimulation due to pain of surgery or any other causes [8-10]. There are also evidences in animal studies that magnesium blocks the release of catecholamines and vasopressin in spontaneous hypertension [11] and it is one of the important agents in therapeutic regimens of hypertensive crises in preeclampsia [8]. Also this drug is useful in tetanus and pheochromocytoma, which are situations of excess catecholamine release [8,16]. There are some studies that showed beneficial effects of using Mg sulfate in aortic cross clamp situations to improve renal perfusion by its vasodilatory effects [15]. Mg sulfate reduces intra operative hypnotic requirements and in combination with analgesic agents, it possesses some antinociceptive activity [12-15], as we observed less volatile anesthetic consumption in group M and the target MAP was achieved with less remifentanil consumption. Patients in group P had lower mean heart rate, which might be due to higher remifentanil doses in this group. We also recorded fewer incidences of post-operative nausea and vomiting,
which may be the result of less opioid and volatile anesthetic consumption in group M intraoperatively [22-23].

One of the applications of Mg sulfate is to treat postoperative shivering [24], in this clinical trial, we had significant less incidence of shivering in group M, and this may be the result of prophylactic effect of Mg sulfate for shivering [25-27].

In this study we also recorded lesser pain scales in PACU in patients of Mg sulfate group which may confirm the preemptive effect of Mg sulfate [28] or it may be the result of the hyperalgesia caused by infusion of higher doses of remifentanil in control group [29-31].

Unfortunately, we did neither measure serum concentration of Mg intraoperatively nor postoperatively. But none of the patients who received Mg sulfate showed any evidence of clinically significant residual neuromuscular block in the PACU which probably is the result of administration of just a single intubating dose of muscle relaxant at the beginning of anesthesia process and not repeating any additional dose of muscle relaxant during the remaining anesthesia time until the end of surgery.

Conclusion

As conclusion we found that Mg sulfate as a useful agent for controlled hypotension in rhinoplasty, because by administering this agent to the patients, they bleed less, the operation time was reduced, and besides greater surgeon’s satisfaction and several other advantages as discussed earlier.

References

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